

The Paryphantidae of New Zealand

No. VI. Distribution, hybrids and new species of Paryphanta, Rhytida and Schizoglossa.

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ABSTRACT.

A distributional survey, with map, of the *Paryphanta lignaria* group of subspecies, from Buller County, West Coast, New Zealand. Hybrid colonies resultant from river floods, attributable in two instances, to the Mokihinui River flood following the 1929 Murchison Earthquake. Evidence on speciation in support of Mayr's views on hybrid populations. New species and subspecies of *Paryphanta* (4), *Rhytida* (2), and *Schizoglossa* (2).

Genus PARYPHANTA Albers, 1850.

Subgenus POWELLIPHANTA O'Connor, 1945.

1. THE LIGNARIA SERIES.

In 1946 (Rec. Auck. Inst. Mus. 3 (2), p. 106) I recorded the difficulties encountered in the exact interpretation of Hutton's *lignaria*. The chief points are as follows:—

(1) The holotype is not in the Canterbury Museum as stated by Suter (Man. N.Z. Moll. p. 783), but was returned to its discoverer, Dr. Gaze, of Westport (Suter l.c. errata, p. XIV).

(2) The type locality was given as "the saddle between the Mokihinui and Lyell Rivers."

(3) The type specimen was described as "irregularly banded in the direction of the growth lines with dark reddish-brown and pale brownish-yellow"—"upper surface finely irregularly granulated by deeply undulating impressed lines." "The lower surface is broken off, so as to leave the shape of the umbilicus and the aperture uncertain." "Greatest diameter about 2 inches and least diameter 1½ inch."

(4) In 1900 Hutton figured an example without colour bands, said to come from Mt. Rochefort, near Westport, and erroneously ascribed it to his original *lignaria*. This specimen is evidently my *unicolorata* (see next reference) and came from Seddonville. Mt. Rochefort specimens recently obtained by both Dr. W. R. B. Oliver and Mr. W. H. Johnston are a new subspecies of *rossiana*, described following.

(5) In 1930 (Rec. Auck. Inst. Mus. 1 (1), p. 42, Pl. 4, f. 1) I identified shells from St. Helens, Mokihinui, as Hutton's original *lignaria*.

(6) In 1941 (l.c. 2 (5), p. 239) I nominated a St. Helens, Mokihinui, specimen as neotype of *lignaria*, since the holotype was presumed to have been lost.

(7) In 1946 (l.c. 3 (2), p. 106) I recorded the finding of an unlabelled specimen from the collection of the late Mr. Boswell, of Westport, which may be Dr. Gaze's specimen, holotype of Hutton's original *lignaria*. This specimen tallies with Hutton's description except for the dimensions, which are slightly greater than those given by Hutton—viz. $2\frac{1}{8}$ inches x $1\frac{3}{4}$ inches. However, since the base is missing, the body-whorl has undoubtedly sprung or spread, and this would account for the present slightly greater dimensions. Also, it should be noted that Hutton qualified his dimensions, with "about." If this specimen is Hutton's type, then my 1930 and 1946 interpretation of *lignaria* is correct, but the locality cited by Hutton is not.

(8) No specimens from Hutton's alleged type locality have since been found.

(9) In 1946 (l.c. 3 (2), p. 106) I recorded a specimen from the collection of Mr. Arthur Richardson, of Papakura, said to have come from Larrakin's Creek, a tributary of the South Branch of the Mokihinui River and draining the high watershed between the Mokihinui and Matiri Rivers, which is near to Hutton's alleged type locality. However, Mr. W. H. Johnston, of Seddonville, reports that local deer stalkers have been unable to find any snails in the Larrakin's Creek area; and, further, that Mr. E. De Malmanche, from whom Mr. Richardson got the specimen, actually found it at river level about a mile up the South Branch of the Mokihinui. Since the numerous subspecies of "*lignaria*" occupy relatively small areas, the Richardson specimen cannot be considered topotypic of *lignaria*. Reconsideration shows it to be a *unicolorata* x *ruforadiata* hybrid.

(10) Several deer stalkers have since traversed the high tops in the vicinity of the "Mokihinui-Lyell" Saddle, but failed to find any large snails. If *Paryphanta* snails do materialise from this area a form of *rossiana* is to be expected, and any such would scarcely fit Hutton's description of *lignaria*.

(11) My conclusion now is that Hutton's *lignaria* definitely applies to the St. Helens shells and that the locality originally cited is incorrect.

The specimen selected for the neotype, however, was an empty shell and has been stained slightly, and appears more reddish-brown than in fresh material.

This last point is important, since there are two distinct colour forms of *lignaria*.

In a paper "The Species Problem in New Zealand Land Snails" read at the New Zealand Science Congress, Wellington, 1947 (Powell, 1949, Trans. Roy. Soc. N.Z. 77 (5))* I described at some length the distribution of the *lignaria* group of snails and the probable genetical and other factors involved, which are summarised as follows:—

(1) Over 400 square miles of more or less continuous forest, between the Mokihinui and Little Wanganui Rivers, is occupied by two colour forms of *lignaria*, one (typical) from the southern drainage has

* Not published at time of going to press.

a yellowish or greenish-yellow ground colour, while the other from the northern drainage has a reddish-brown ground colour.

(2) The two colour forms of *lignaria* cannot be accounted for under clinal variation, since no intermediates were found. Each colony so far located has been either one colour or the other, and strictly in relation to the other colonies of the side of the range it occupies.

(3) Probable polymorphic nature of the species is suggested. It may be that the yellowish ground colour of the snails from the Mokihinui side is due to infiltration over a long period by the khaki coloured *unicolorata* from the south side of the river, and by the same criterion the reddish-brown ground colour of those from the northern drainage may be due to former contact or infiltration from a reddish stock now represented by *annectens* from north of the Karamea River.

(4) That infiltration does occur is definitely shown by hybrid colonies at Sawyer's Creek, a tributary of the Mokihinui River, at St. Helens, and also at Summerlea on the opposite or southern side of the river near the mouth (see note on these hybrid populations, p. 354).

(5) Since *lignaria* and *unicolorata* freely hybridise when chance mixing occurs, they are better evaluated as subspecies than species.

1a. The *lignaria* group of subspecies.

LOCALITY KEY.

Leslie and Upper Karamea Rivers	<i>lignaria oconnori</i>
Little Wanganui to Corbyvale	<i>lignaria lusca</i>
Kongahu Point—Carlins Flat to Mokihinui River	<i>lignaria lignaria</i>
Seddonville Flat and river flats of Mokihinui South Branch ..	<i>lignaria unicolorata</i>
North branch and north bank, Mokihinui Gorge	<i>lignaria ruforadiata</i>
Western drainage, Glasgow Range	<i>lignaria rotella</i>
Coast range, bounded by sea, Mokihinui and Ngakawau Rivers, Chasm and Charming Creeks	<i>lignaria johnstoni</i>

COLOUR PATTERN KEY.

- (A) Conspicuous radial streaks.
- a. Numerous radials.
 1. On a yellowish ground colour *lignaria lignaria*
 2. On a reddish-brown ground colour *lignaria lusca*
 - b. Wide spaced radials.
 3. On an orange-brown ground colour *lignaria oconnori*
- (B) Inconspicuous broad reddish-brown streaks.
4. On brown to raw-umber ground *lignaria ruforadiata*
- (C) Sparse narrow radial dark lines.
5. Ground colour reddish-brown spirally lined above, khaki below
..... *lignaria rotella*
- (D) Conspicuous spiral reddish-brown lines and zones, above and below
..... *lignaria johnstoni*
- (E) Plain khaki, above and below *lignaria unicolorata*

***Paryphanta lignaria lignaria* Hutton, 1888.**

1888. *Paryphanta lignaria* Hutton, Trans. N.Z. Inst. 20, p. 43.

1913. *Paryphanta lignaria*: Suter (in part), Man. N.Z. Moll., p. 783.

1930. *Paryphanta lignaria*: Powell, Rec. Auck. Inst. Mus. 1 (1), p. 42, Pl. 4, f. 1.

1941. *Paryphanta lignaria*: Powell, Rec. Auck. Inst. Mus. 2 (5), p. 239 (Neotype).

The typical subspecies has a yellowish ground colour (olive lake, Ridgway, 1912, pl. 16) on the base, and russet (Ridgway, pl. 15*) on the dorsal surface. The colour division occurs sharply, just above the periphery, and coincides with the outer extremity of the spiral sculpture. The whole shell is axially striped and banded with dark reddish-brown to almost black. There is a general tendency towards narrow stripes with much of the ground colour showing.

Localities: "Saddle between Mokihinui and Lyell Rivers, Nelson" (Type locality, but evidently incorrect); About 1½ miles up Marris' Tramway, near junction of Mumm and Stillwater Creeks, St. Helens, Mokihinui, 120 feet (Neotype, Powell, 1941, Rec. Auck. Inst. Mus. 2 (5), p. 239); Between Sawyer's and Stillwater Creeks, St. Helens, Mokihinui, 80-100 feet (A.W.B.P. and A. C. O'Connor, 1947); Hill-top, 899 feet, west of Sawyer's Creek (A.W.B.P. and A. C. O'Connor, 1947); Old Man Rock, 300 feet, Kongahu Point, six miles north of Mokihinui River (A. Richardson); First watercourse Mokihinui-Karamea Road; The Bluff or View Hill Saddle, 1376 feet, Mokihinui-Karamea Road (A.W.B.P., 1947, and A. C. O'Connor, March, 1949); Carlin's Flat, head of Six Mile Creek, 660 feet, Mokihinui-Karamea Road (A.W.B.P. and R. A. Prouse, 1948).

Major diameter, 47.0 mm.; min. diam., 39.0 mm.; height, 26.0 mm. (Neotype)

Major diameter, 56.5 mm.; min. diam., 47.0 mm.; height, 32.0 mm. (St. Helens)

Major diameter, 65.0 mm.; min. diam., 57.0 mm.; height, 38.5 mm. (St. Helens)

Neotype: Powell Collection, Auckland.

***Paryphanta lignaria lusca* n. subsp. Pl. 66, fig. 2.**

This subspecies has a uniformly reddish-brown ground colour, not bi-zoned as in the typical species. The ground colour varies through Buckthorn brown, russet and Mars brown (Ridgway, 1912, pl. 15). There is a general tendency towards wide axial bands with little of the ground colour showing.

The shell is more solid and the spire more elevated than in the typical subspecies.

Localities: Glass-Eye Creek, Mokihinui-Karamea Road (A.W.B.P. and A. C. O'Connor, 1947); lower slope of small hill west side of Mokihinui-Karamea Road at Corbyvale (A.W.B.P. and R. A. Prouse, 1948); hill on south side of Lower Glass-Eye Creek, ca. 900 feet, Little Wanganui (A.W.B.P. and A. C. O'Connor, 1947).

On the Mokihinui Road the division between *lignaria lignaria* and *lignaria lusca* occurs over the short distance of one mile between Carlin's and Corbyvale, but on the coast the division has not as yet been recorded. A transverse ridge runs between Carlin's and Corbyvale and terminates on the coast at Kongahu Point. The snails, however, seem to be distributed in relation to stream valleys rather than to the ridges, the latter being for the most part steep with little humus and consequently very few earthworms (worms form the staple diet of these snails).

* Ridgway, R., 1912. Color Standards and Color Nomenclature. Washington, U.S.A.

The streams associated with the typical subspecies are Sawyer's, Stillwater, Mumm, Tobin, Three Mile, Sandel and Six Mile Creeks. Their drainage is mainly west and south. The subspecies *lusca* is associated with Glass-Eye and Fall Creeks, both of which have a north-west drainage.

Major diameter, 55.5 mm.; min. diam., 46.0 mm.; height, 33.0 mm. (holotype)

Major diameter, 57.5 mm.; min. diam., 48.0 mm.; height, 35.0 mm. (paratype)

Holotype: Auckland Museum.

Paryphanta lignaria oconnori Powell, 1938.

1938. *Paryphanta lignaria oconnori* Powell, Rec. Auck. Inst. Mus. 2 (3), p. 134, Pl. 33, figs. 3-6.

This subspecies is evidently confined to the upper drainage of the Karamea and Leslie Rivers, but does not descend to the coastal stretch between the Little Wanganui and Karamea Rivers. I have searched much of the low forested hills around the Whangapeka Valley without success, although local farmers reported having seen large snails carried down over the flats by floods.

Localities: Headwaters of the Leslie River, tributary of the Karamea River, 2,000 feet; between Gordon's Pyramid, 4,900 feet, and Mt. Arthur, 5,834 feet, western slopes of Mt. Arthur Tableland (type). Two miles south of the Karamea River and eleven miles E.N.E. of Karamea township, 500-1,500 feet. A large colony in mixed forest, covering an area of at least one square mile and extending indifferently over Altonian mudstone, limestone and granite (H. W. Wellman, 1948).

1b. The unicolorata group of subspecies.

In general terms the Mokihinui River forms a barrier between the *lignaria* and *unicolorata* populations, the former to the north and the latter to the south of the river.

I have already shown that contrary to expectation *Paryphanta* snails will survive floods, even prolonged submergence, and that during these floods living snails may be transported. This is effectively demonstrated by the occurrence of at least two hybrid colonies (*lignaria* x *unicolorata*), one at Sawyer's Creek, St. Helens, on the north side of the Mokihinui River and the other at Summerlea on the south side of the river near the mouth.

In April, 1948, I found a living example of *unicolorata* under driftwood at Sawyer's Creek bend, where it had obviously come to rest after a flood, which occurred during the previous week.

The great flood following the 1929 Murchison Earthquake must have transported large numbers of snails, many of which no doubt escaped destruction by being carried inshore at bends. It is likely that the large colony of hybrids at Summerlea owes its origin to this 1929 flood.

Mr. W. H. Johnston's valuable field work, coupled with that of Mr. H. Wellman and my own investigations in collaboration with Mr. A. C. O'Connor and Messrs. R. A. and H. S. Prouse, have resulted in fairly comprehensive mapping of the distributional areas occupied by the several subspecies. Although many of the colonies show hybrid influences, at least four geographic subspecies are recognisable,

- (1) *unicolorata*. Plain khaki coloured, top and base. Western side of the South Branch of the Mokihinui River and down through the south side of the gorge to the Seddonville Flat (type locality).
- (2) *ruforadiata*. Brown to raw umber with broad sparse dark reddish-brown radial streaks. Maori Gully and North Branch (type locality) of the Mokihinui River and down the north side of the gorge. Hybridising with *unicolorata* on the south side through the gorge and near the railway tunnel below Seddonville.
- (3) *rotella*. Top reddish-brown, base khaki. Spiral colour lines on top and base with sparse radial narrow dark bands. Western drainage of Glasgow Range, including Hydro (State) Mine Ridge, above Seddonville. As a slight hybrid influence in *unicolorata* colonies at Seddonville.
- (4) *johnstoni*. Spiral colour lines and zones, top and base. In forest and on high-level silver pine "pakihis." Isolated block bounded by Mokihinui River to the north, Ngakawau River to the south, the sea to the west, and two deeply cut streams to the east, Chasm Creek and Charming Creek. Slight infiltration between *johnstoni* and *rotella* where the upper reaches of the two streams are less effective as barriers.

***Paryphanta lignaria unicolorata* Powell, 1930.**

1900. *Paryphanta lignaria* Hutton (not of Hutton, 1888), Trans. N.Z. Inst. 32, p. 22, Pl. 2.
1930. *Paryphanta unicolorata* Powell, Rec. Auck. Inst. Mus. 1 (1), 43, Pl. 4, f. 2, and Pl. 6, f. 6.
1946. *Paryphanta unicolorata*: Powell, Rec. Auck. Inst. Mus. 3 (2), p. 107.

Localities: Seddonville, West Coast (type), from around flax (*Phormium*) (C. L. Wragge); "Mt. Rochefort," Hutton's locality for his 1900 record of "*lignaria*" is evidently erroneous, the specimen being a *unicolorata* probably from the Seddonville area; Seddonville flat, under blackberry bushes, willows, and decaying logs from between railway station and Mokihinui River. The area was formerly in heavy lowland rainforest. Includes about 5% with "*rotella*" influences, i.e., light-brown spiral lines on the dorsal surface and irregularly disposed dark-brown axial streaks (A. C. O'Connor and A.W.B.P., 1947); Pigeon Island and small island adjoining it, Mokihinui River above Seddonville, map S. 25, ref. ca. 455975 (W. H. Johnston, 1946) (slight *ruforadiata* influence); Between Chasm Creek and Page's Creek, above road, $\frac{3}{4}$ mile N.W. of Seddonville (W. H. Johnston and A.W.B.P., Jan., 1947) (strong *ruforadiata* and moderate *rotella* influences); Between Chasm Creek and Page's Creek, below road and railway to river-bank (W. H. Johnston and A.W.B.P., Jan., 1947) (moderate *ruforadiata* influence); Between railway tunnel, Chasm Creek and Mokihinui River (W. H. Johnston and A.W.B.P., Jan., 1947) (strong *rotella* influence); 1 mile east of Seddonville, river terrace, old Karamea Road (W. H. Johnston and A.W.B.P., Jan., 1947) (strong *ruforadiata* influence); Lake Perrine (formed by 1929 earthquake), south side below junction of North and South branches of Mokihinui River; Limestone Creek, west side of South Branch, Mokihinui River, map S. 25, ref. ca. 628948 (F. Hughes); Owen Creek, west side of South Branch, Mokihinui River, map S. 25, ref. ca. 614887 (F. Hughes); Junction of Specimen Creek and Mokihinui River, map S. 25, ref. 592977 H. Wellman, 1948) (moderate *ruforadiata* influence); Welcome Creek, south side of Mokihinui River Gorge, map S. 25, ref. ca. 488967 (W. H. Johnston and A.W.B.P., April, 1948) (moderate *ruforadiata* influence); Coal Creek, south side of Mokihinui River, 1 miles E. of Seddonville, map S. 25, ref. ca. 458964 (W. H. Johnston, March, 1947) (strong *ruforadiata* influence); Johnny Cake Creek to within $\frac{1}{2}$ mile of Andersen Creek, Mokihinui Gorge, south side, 80 feet above river, map S. 25, ref. ca. 505982 (W. H. Johnston, 20/3/1947) (strong *ruforadiata* influence); Welcome Creek to Johnny Cake Creek, Mokihinui Gorge, up to 300 feet above river, map S. 25, ref. ca. 493970 (W. H. Johnston, 20/3/1947).

The subspecies *unicolorata* belongs for the most part to the river flats of the South Branch and the southern side of the Mokihinui River. Owing to the mixing or infiltration caused by flooding, most of the colonies exhibit hybrid influences to some degree. Where the colonies are large the effect of mixing is scarcely apparent, but numerically small occurrences may be strongly influenced by infiltration. The prevalence of hybrids is not general in *Paryphanta* populations, but a local phenomenon caused in this instance by an imperfect water barrier in an area of large snail concentrations.

***Paryphanta lignaria rotella* Powell, 1938. Pl. 64, figs. 4 and 5.**

1938. *Paryphanta unicolorata rotella* Powell, Rec. Auck. Inst. Mus. 2 (3), p. 137, Pl. 33, figs. 8 and 9.

1946. *Paryphanta unicolorata rotella* Powell, Rec. Auck. Inst. Mus. 3 (2), p. 107.

Localities: Between headwaters of St. Andrew's and St. George's Streams, tributaries of the Ngakawau, at 1,200 feet, western slopes of Glasgow Range, Buller (type); western slopes of Glasgow Range, 1,100-2,000 feet; north side of St. Andrew's Stream, on "pakihi," 1,300-1,400 feet (W. H. Johnston, A. C. O'Connor and A.W.B.P., Jan., 1947); ridge between Coal Creek and Chasm Creek, 700 feet (W. H. Johnston); ridge above the Hydro. (State) Mine, Seddonville, 400-500 feet, map S. 23-24, ca. 448955 (W. H. Johnston, A. C. O'Connor and A.W.B.P., Jan., 1947).

The species occurs sparsely, mostly in silver pine "pakihi" areas, but is widespread on the higher slopes of the western drainage of the Glasgow Range. It penetrates to the lower levels down a leading spur to the vicinity of Seddonville, where it is a slight hybrid influence in the low level *unicolorata* colonies on the Seddonville Flat and between the Seddonville railway tunnel and Page's Creek.

A figure (pl. 64, figs. 4, 5) of a toptype shows the characteristic colour pattern more clearly than in the 1938 figured holotype.

***Paryphanta lignaria ruforadiata* n. subsp. Pl. 64, figs. 1 and 2.**

This subspecies is of similar shape and size to *unicolorata*, but has a much darker ground colour (Brussels brown to raw umber, Ridgway, pl. 3) plus a radial pattern of broad, rather sparse, somewhat irregular, dark reddish-brown streaks, about nine on the body-whorl. Parietal callus bluish grey. Dorsal surface to periphery finely malleate-striate as in *unicolorata*.

Major diameter, 47.5 mm.; min. diam., 40.75 mm.; height, 29.0 mm. (holotype)

Localities: Five miles north of junction of north and south branches of Mokihinui River, on flat, 20 feet above river, in fairly open *Nothofagus* forest (type, W. Kelly, Feb., 1947); Two miles up Maori Gully, near North Branch of Mokihinui River (H. Wellman, 1948); North bank of Mokihinui River, $\frac{3}{4}$ mile above main highway bridge at St. Helens (W. H. Johnston, 1946) (4 typical and 13 hybrids, *unicolorata* x *ruforadiata*); North bank of Mokihinui River, $\frac{1}{2}$ mile above main highway bridge at St. Helens (W. H. Johnston, 1946); Between Sinclair and Stony Creeks, east side, South Branch of Mokihinui River, map S. 25, ref. ca. 645945 (F. Hughes, Dec., 1947) (one example, showing *unicolorata* influence). This is the actual locality from which Mr. E. De Malmanche obtained the specimen recorded in my 1946 paper (Rec. Auck. Inst. Mus. 3 (2), p. 106) as from Larrakin's Creek, on the authority of Mr. A. Richardson. The De Malmanche specimen is evidently a hybrid, *ruforadiata* x *unicolorata*, but a series will be necessary to determine the status of this colony. Mr. H. Wellman has recently traversed the Larrakin's Creek area without locating any snails.

The subspecies *ruforadiata* is present also as a hybrid influence in a number of colonies on the south side of the Mokihinui River through the gorge and between the railway tunnel and Page's Creek, below Seddonville (see locality list for *unicolorata*).

Holotype: Auckland Museum, presented by Mr. W. H. Johnston.

***Paryphanta lignaria johnstoni* Powell, 1946. Pl. 65, fig. 9.**

1946. *Paryphanta unicolorata johnstoni* Powell, Rec. Auck. Inst. Mus. 3 (2), p. 107, Pl. 9, figs. 3, 4.

Localities: West side of Chasm Creek towards junction with the Mokihinui River, 100-500 feet (W. H. Johnston, 1945) (type); 50 feet above Mokihinui River near road-railway crossing west of Seddonville Tunnel (W. H. Johnston); Maloney's Track from above Seddonville Tunnel to Trig AO, 1,352 feet, map S. 23-24, refs. 435980-411963, in "pakihi" and rain forest (W. H. Johnston, A. C. O'Connor and A.W.B.P., Jan., 1947); From Trig AO to Lowe Stream, tributary of Chasm Creek, 1,040 feet, at ca. 430948; near Charming Creek Coal Mine, east side of Creek, 500 feet, at ca. 408927 (W. H. Johnston, 11/2/1949); Ratcliffe Ridge (Radcliffe on maps), coastal range between Mokihinui and Ngakawau Rivers, vicinity of Trig AM, 1,749 feet, ca. 375938 (W. H. Johnston, R. A. Prouse, and A.W.B.P., April, 1948).

The species lives around the margins of "pakihis" as well as in the forest. It occurs in a number of scattered concentrations without apparent continuity.

Most examples from Ratcliffe Ridge have a striking bi-zoned base; plain khaki around the umbilicus, but over the rest of the base and top the deep red-brown spiral bands are so closely spaced that little of the ground colour shows. A small percentage have spaced narrow spiral bands and lines on a light ground as in the holotype. The Charming Creek Mine examples are typical, but those from the Trig AO-Lowe Creek traverse have narrow to faint lines on the base and approach *rotella*.

My 1946 (l.c. p. 108) forecast that *johnstoni* was likely to occupy the entire block bounded by the Mokihinui and Ngakawau Rivers, the sea and Charming and Chasm Creeks proves to be correct. There is an eastern infiltration into the *rotella* area at the Charming Creek Mine, and those from near Lowe Creek show considerable *rotella* influence, but the major part of the *johnstoni* area breeds true to type.

A figure (pl. 65, fig. 9) of a Ratcliffe Ridge example is given to show the maximum development of the *johnstoni* pattern.

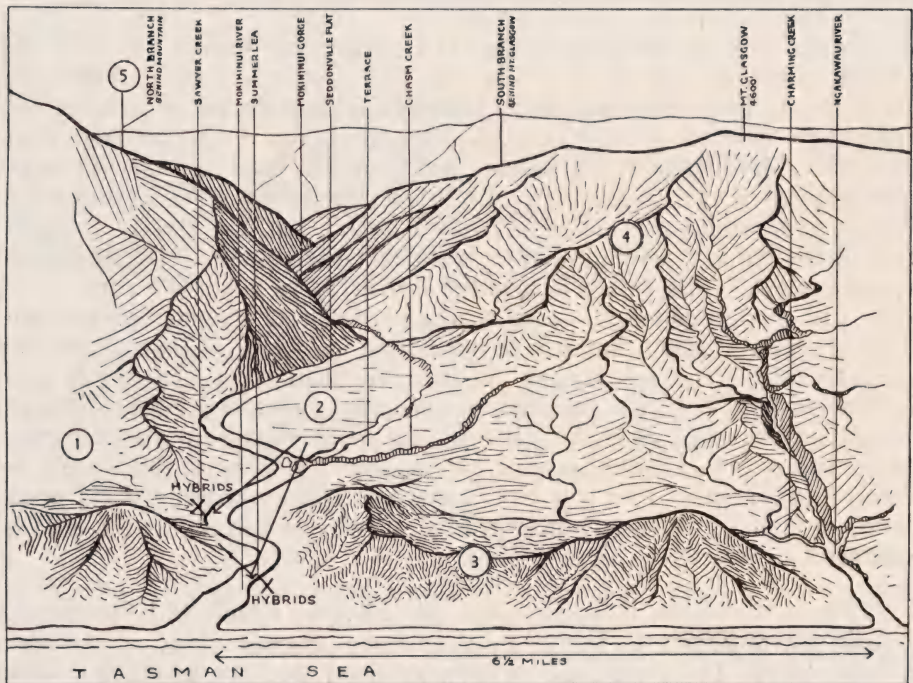
Collapsed and badly stained shells are abundant around the Burning Mine, Millerton, on the plateau to the south of the Ngakawau River. They have a *johnstoni* pattern of closely spaced, narrow lines plus broad radial dark streaks. The material, however, is too imperfect to evaluate this form. Neither Mr. Corbett, the finder of these snails, nor Mr. W. H. Johnston, have succeeded in locating living material.

1c. Hybrid Populations (*lignaria* x *unicolorata*).

I have already reported upon two significant hybrid colonies, *lignaria* x *unicolorata* (Powell, 1949, Trans. Roy. Soc. N.Z., Vol. 77 (5), pp. 203-206), one from Sawyer Creek Bend and the other from near the mouth of the Mokihinui River at Summerlea on the south bank. The

inference is that both hybrid populations owe their origin to the considerable displacement of snails that must have been occasioned by the big flood following the 1929 Murchison Earthquake.

The Summerlea colony (pl. 66, fig. 1) is of special interest, since both components, *lignaria* and *unicolorata*, do not normally occur in the area, but have been transported respectively from across the river in the case of *lignaria* and higher up on the Seddonville Flat in the case of *unicolorata*. The only large snail normally belonging to the block covering the Summerlea site is *johnstoni*, but it is restricted to higher ground.



TEXT FIG. A. Approximate diagram of Mokihinui West Coast, looking east from the sea. The numbered symbols are: 1 = *lignaria lignaria*, 2 = *lignaria unicolorata*, 3 = *lignaria johnstoni*, 4 = *lignaria rotella*, and 5 = *lignaria ruforadiata* n. subsp.

The Summerlea hybrids range from large-sized almost pure *lignaria* (64 mm.) to a few almost pure *unicolorata* (40-47 mm.). The bulk of the colony is made up of intermediate sized snails exhibiting sparse to moderate radial banding which is in the form of narrow dark-brown radials or broad reddish-brown radial streaks. Some forms almost approximate the subspecies *ruforadiata* from the North Branch of the Mokihinui.

The Sawyer Creek hybrids are numerically few and their influence is rapidly absorbed by the surrounding extensive *lignaria* population. These hybrids were observed only within about 400 sq. yds. and not more than 50 feet above river level, and only at this bend of the river which is favourably situated for the stranding of flood-borne snails.

Should the *Summerlea* colony continue to flourish and it escapes further large-scale infiltration by flood-borne stock, still another sub-specific form may evolve.

Even upon the existing data it is fairly conclusively shown that new forms could arise from such rare accidents as the Murchison Earthquake flood.

Mayr, 1942 (*Systematics and the Origin of Species*, p. 263) gives some interesting observations on hybrid populations which apply to the "allopatric" forms (i.e., forms that are normally separated geographically) encountered in the Mokihinui River drainage.

Mayr (l.c., p. 263) states that if a geographic barrier is lifted any of four processes may occur: "(1) The two populations have, during the isolation, developed to full species, which are reproductively isolated and sufficiently distinct in their ecological requirements not to be close competitors. The lifting of the barrier will generally lead to a broad mutual overlapping of the ranges. (2) The two populations have developed to full species, which are reproductively isolated, but are closely competitive owing to non-development of sufficient differences in the ecological requirements. The result is a narrow overlap in a border zone . . . (3) The two populations have acquired different habitat preferences during their isolation, but not reproductive isolation. This results in a curious interlacing of ranges, with hybridization at the borders of habitats. (4) The two populations have not perfected either different habitat preferences or biological isolating mechanisms that would guarantee reproductive isolation and consequently will hybridize freely on coming into contact. In this case a more or less extensive hybrid population, a zone of secondary intergradation, will be formed in the area of contact."

From the above it is clear that the Sawyer Creek and *Summerlea* hybrid populations are covered by the fourth process. That is, the component forms are distinctive so long as they are kept apart, but since reproductive isolation has not obtained they will freely hybridise where the barrier falls down as in the case of these flood-mixed populations.

A partial ecological difference exists between the components—i.e., *unicolorata* belongs to the river flats, but *lignaria* occurs from sea level to the vicinity of 1,000 feet. This limits the possibility of hybridization to the low country, and thus the major area of the *lignaria* population is free from hybrid influence.

Since such apparently distinctive forms as the plain coloured *unicolorata* and the axially banded *lignaria* will freely hybridise when isolating factors cease to operate, it is reasonable to suppose that other more remotely situated forms would do likewise if brought together.

I have anticipated this revaluation in a footnote to my paper "The Species Problem in New Zealand Land Snails," *Trans. Roy. Soc. N.Z.* 77 (5), p. 205: "The separation between *lignaria* and *annectens* is absolute, but I have shown that *lignaria* and *unicolorata*, which under conditions of isolation are quite distinct both in colour and in form, will freely hybridise when brought together. It is likely, therefore, that a

reconsideration of values may result in the admission of fewer species and more subspecies and that my groups (i.e., *busbyi*, *traversi*, *hochstetteri*, *gilliesi*, *lignaria* and *rossiana*) will represent the species."

Mayr's first process, which covers two populations that have developed into full species during former isolation that no longer exists, is demonstrated by the distribution of two species of *Rhytida* in the Waitakere Ranges, Auckland. The species concerned are *greenwoodi*, mainly Auckland and south of Auckland, and *dunniæ*, mainly north of Auckland. Fluctuation in the topography of the Manukau Estuary has evidently admitted *greenwoodi* to the northern area and both now have an irregularly interpolated distribution in the Waitakere area, but no hybrids have been observed.

2. THE ROSSIANA SERIES.

This group of snails consists of relatively small species, 30-40 mm. in diameter, very thin, composed almost entirely of chitin, dark greenish or brownish, radially streaked with darker brown and highly polished. They occur in a number of isolated localities at altitudes between 2,500 and 3,700 feet, mostly in tussock and above the bush line.

A former continuity is suggested, extending from at least the Otago Cold Lakes across to the western side of the Southern Alps and up to the Millerton and Denniston Plateau, north of the Buller. An occurrence at Kirwan's Hill, 3,500 feet, seven miles N.E. of Reefton (*P. cf. gagei*, Powell, 1938, Rec. Auck. Inst. Mus. 2 (3), p. 136), indicates that the Millerton-Denniston snails were derived via an inland route—Orikaka, Buller and Inangahua Rivers.

It is likely that the assumed once extensive distribution of these snails was largely obliterated by Pleistocene glaciation and that the group survived only under exceptional circumstances where the ice-sheet did not form a continuous cover. Mr. H. Wellman, to whom I am indebted for the idea, visualised the possibility, in the case of Mt. Greenland, of an outlier from the Alps which rose above or parted the assumed surrounding cover of ice. Some of the forms, *fletcheri* for instance, show a great tolerance for snow, which must cover the habitat for many months of the year.

Although the *rossiana* series show comparative uniformity in size, build and coloration, there is one significant point which separates them into two groups, and that is egg size. Mr. A. C. O'Connor (1945, Trans. Roy. Soc. N.Z. 75, p. 54) has shown that *spedeni* "is the 'kiwi' of the family" in that, like the bird, it produces an egg disproportionately large for the size of the parent. Thus the egg of *spedeni*, in contrast with that of the *rossiana* group, is actually the equal of that of *hochstetteri*, a very much larger snail.

In the light of modern evaluation of species and subspecies, especially the suggestion that geographic isolation does not necessarily mean reproductive isolation, the possibility of the actual or potential breaking down of barriers makes reconsideration of taxonomic values necessary. Although the existing barriers between all the *rossiana* forms appear to be absolute, there is no guarantee that reproductive isolation has

obtained and that artificial mixing of forms would not produce hybrids. Unfortunately the life span of these snails (probably 10-15 years) is too long for practical hybridization experiments.

On account of the strong upper surface striation, coupled with the egg size anomaly in *spedeni*, I consider it specifically distinct from *rossiana*, with which the remaining forms are associated as subspecies.

LOCALITY KEY.

Southland, W. side Mataura River, 3,200 feet	<i>spedeni spedeni</i>
Southland, Billow Mts., 3,000 feet, S.W. of Lake Mōrowai ..	<i>spedeni lateumbilicata</i>
Westland, Mt. Greenland, 2,900 feet, and Mt. Rangitoto, near Ross, ..	<i>rossiana rossiana</i>
Westland, Mt. Tuhua, 3,688 feet, E. of Lake Kanieri	<i>rossiana fletcheri</i>
Grey, Seven Mile Stream, 2,800 feet, Rewanui, Greymouth	<i>rossiana gagei</i>
Inangahua, Kirwan's Hill, 3,500 feet, 7 m. N.E. of Reefton	<i>rossiana cf. gagei</i>
Buller, St. Patrick Stream, 2,500 feet, Millerton and Denniston	<i>rossiana patrickensis</i>

SYSTEMATIC KEY.

Egg large (11-11.5 mm.)

Dorsal surface distinctly striated.

Radials almost absent.

Umbilicus one-tenth diameter

Umbilicus one-eighth diameter

Egg small (6.5-8.5 mm.)

Dorsal surface weakly striated.

Radials inconspicuous.

Umbilicus one-seventh diameter

Dorsal surface smooth.

Radials inconspicuous.

Umbilicus one-ninth to one-tenth diameter

Umbilicus one-sixth diameter

Radials conspicuous.

Umbilicus one-seventh diameter

***Paryphanta rossiana patrickensis* n. subsp. Pl. 65, figs. 10-12.**

Shell small, thin, glossy, almost entirely chitinous, reddish-brown, with numerous radial dark-brown stripes; smooth and polished. Ground colour, varying through antique, argus and Brussels brown above and medal-bronze below (see Ridgway, pls. 3 and 4). The whole shell conspicuously but irregularly striped with narrow dark-brown radials, about 25 on the body-whorl. Between the dark-brown radials there are greenish-brown, faint to moderately strong, subsidiary axial stripes. Umbilicus one seventh major diameter of base.

Major diameter, 35.0 mm.; min. diam., 29.0 mm.; height, 21.0 mm.; depth of body-whorl opposite aperture, 15.5 mm.

Localities: Eastern side of Millerton Plateau, headwaters of St. Patrick Stream on fringe of "pakihi," map S. 23-24, ca. 356795, 2,500 feet (W. H. Johnston, R. A. Prouse and A.W.B.P., 8/4/1948). Very scarce, sheltering under tussock, on swampy ground. Vicinity of Denniston (W. R. B. Oliver, 1948). Between Denniston and Mt. Rochefort and Cedar Creek, S.E. of Denniston, ca. 325745 (W. H. Johnston, Sept.-Oct., 1949).

This subspecies differs from *fletcheri*, its nearest ally, in having a more distinct, regular and dense radial pattern of dark-brown stripes, a wider umbilicus (one-sixth major diameter in *fletcheri*, one-seventh in *patrickensis*), and a more elevated spire. In *rossiana* the spire is still more elevated, the umbilicus narrower, one-ninth to one-tenth the major diameter, and the shell is darker, with the radial stripes inconspicuous.

3. THE TRAVERSI SERIES.

In 1946 (Rec. Auck. Inst. Mus. 3 (2), pp. 115-122) I gave a detailed account of the *traversi* colonies which occur in the forest remnants of the Horowhenua Plain and in a few higher level basins of the foothills of the Tararua Range which flanks the eastern margin of the plain.

Once again I am indebted to Messrs. R. A. and H. S. Prouse, of Levin, for their valuable field work in the area. The lowland forest remnants have now been almost completely investigated and much of the foothills also.

Since my 1946 paper further work in these foothills has revealed several additional colonies and the necessity for nominating an additional form which, under present nomenclatural rules, is best designated as a subspecies.

***Paryphanta traversi latizona* n. subsp. Pl. 64, figs. 6-8.**

Ground colour olive-lake to old gold, sparsely spirally banded, and zoned in mars-brown over the dorsal surface and periphery; rest of base consisting of very numerous closely-spaced thin spiral lines diffused into a dark area of approximately mummy-brown (Ridgway).

In 1946 (l.c. p. 118) I analysed a hundred examples from the type colony for this new subspecies, but did not differentiate the form from *traversi traversi*. Further collecting and a visit personally to the locality has convinced me that it is a high altitude subspecies developed in a small basin under conditions of comparative isolation from other colonies. My analysis was (DMPR 70% + DKPR 30%). These letter symbols used in my 1946 paper are as follows: D = Top more or less completely spirally lined and banded with light to dark reddish-brown. K = Base with very numerous narrow spirals generally diffused. M = Base almost uniformly dark warm-brown with occasional narrow spirals of the pale ground colour showing through towards the outer edge. P = Callus dull purplish-grey. R = Full size (50-55 mm.), showing marked acceleration of the last whorl.

The examination of some hundreds of examples shows this to be a very constant form always with broad spiral bands and zones, but averaging a smaller size than previously indicated, i.e., mostly from 40-43 mm.

Major diameter, 44.0 mm.; min. diam., 37.0 mm.; height, 26.0 mm. (holotype)

Major diameter, 44.0 mm.; min. diam., 37.0 mm.; height, 22.0 mm. (paratype)

The relationship of this subspecies is with *traversi* and *florida* rather than with *tararuaensis* from Kaihinu and Shannon Heights.

Locality: Greenaway's Bush, 700-800 feet, Arapaepae Range, west of Makahika Stream, tributary of Ohau River, Levin. Map N. 152, ca. 895015 (R. A. and H. S. Prouse and A.W.B.P., 1947).

The Arapaepae Range is an outlier from and parallel to the Tararua Ranges. To the west it is bordered by the Horowhenua Plain and to the east by the Makahika Stream. The *latizona* colony occurs in a small high level basin near the commencement of the range, amongst confused topography.

The drainage is to the west and south-west. The vegetation is rain forest with a dense undergrowth of ferns, especially *Blechnum discolor* and *Todea superba*.

Unfortunately the whole of Greenaway's Bush is likely to be cleared within the next few years.

***Paryphanta traversi tararuaensis* Powell, 1938.**

1938. *Paryphanta traversi tararuaensis* Powell, Rec. Auck. Inst. Mus. 2 (3), 138, pl. 33, f. 2.

1946. *Paryphanta traversi tararuaensis* Powell, Rec. Auck. Inst. Mus. 3 (2): 120.

Localities: Kaihinu, Tararua Range, 1,500-2,000 feet, about four miles east of Tokomaru (type); East of and about 500 feet above Shannon Heights Basin, ca. 1,500 feet (R. A. and H. S. Prouse and A.W.B.P., Dec., 1946).

The second locality, 500 feet above Shannon Heights, produces a form of *tararuaensis* which in most individuals exhibits a more reddish top and a base rendered darker by more numerous and darker narrow spiral lines. The reddish dorsal surface is difficult to match with Ridgway's "Colour Standards" but seems to be approximately between madder-brown and hessian-brown.

There are two colonies near the southern edge of Shannon Heights Basin, ca. 1,000 feet, but these show *traversi* and *koputaroa* influences. They were probably derived from the plain, whereas the reddish-topped form from 500 feet above the Basin represents a southern extension of *tararuaensis*.

I now provide a figure of the holotype of *traversi koputaroa* (pl. 64, fig. 3). See Powell, 1946 (l.c.) p. 136.

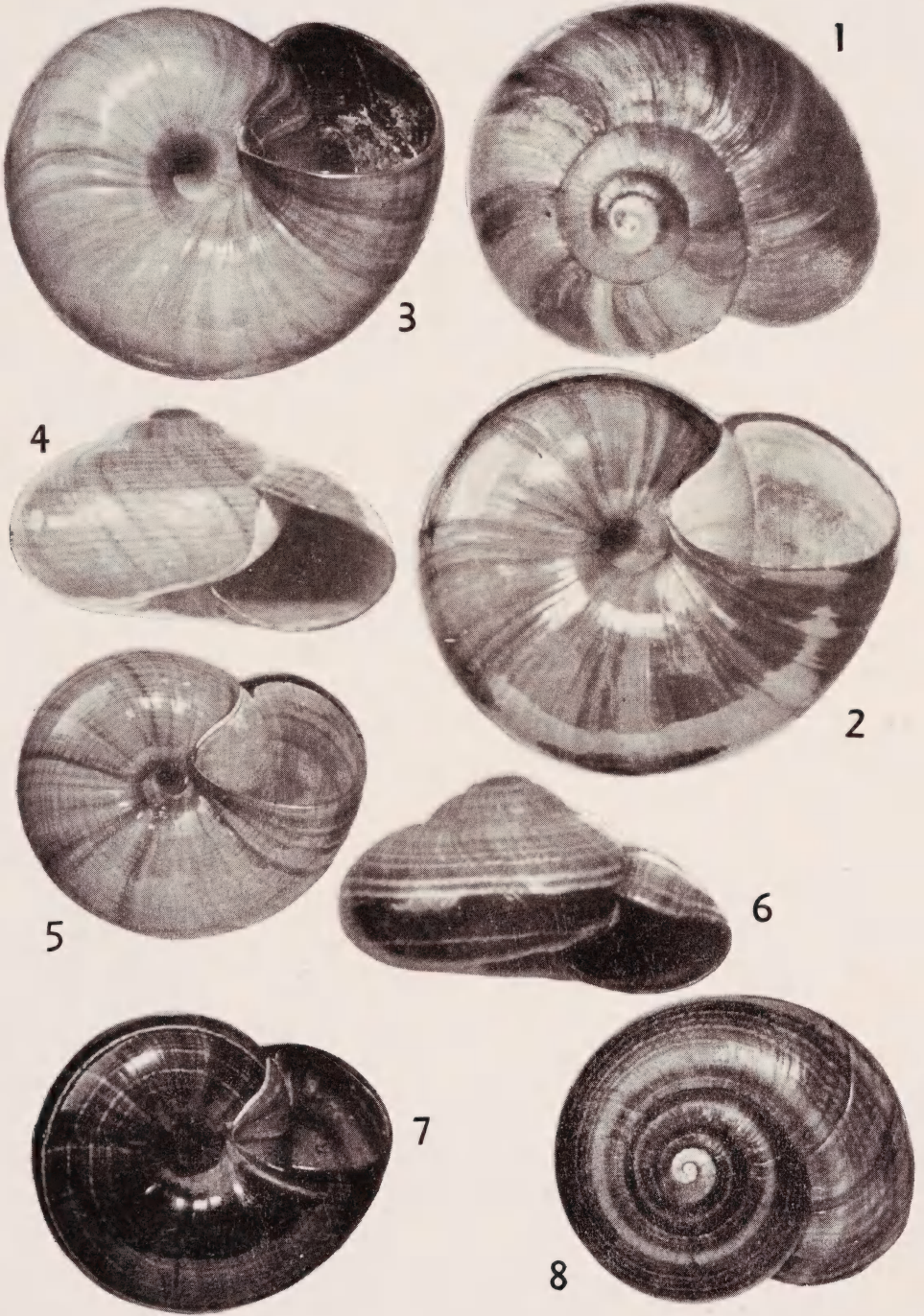
Genus RHYTIDA Albers, 1860.

In Martens Helic. ed. 2, 89.

Type: *Helix greenwoodi* Gray.

As already noted (Powell, 1930 Rec. Auck. Inst. Mus. 1 (1), p. 29), shells from Auckland, the type locality, and most northern North Island occurrences have a dark chestnut umbilical zone. Shells from the southern part of the North Island and the related *stephenensis* from Stephen Island, Cook Strait, are without this zone.

Shells from the following localities have the umbilical colour zone: Auckland, slopes of Mt. Eden and Grafton Gully (Suter collection); Waiaatarua, Waitakere Range, Muriwai West Coast, Auckland, and four miles south of Waiuku (A.W.B.P.); Oneroa, Palm Beach and Omiha, Waiheke Island, Moehau, Coromandel Peninsula and Taupiri Mountain (A.W.B.P.).



1. *Paryphanta lignaria ruforadiata* n. subsp. Paratype. 2. *P. lignaria ruforadiata* n. subsp. Holotype, 47.5 x 29.0 mm. 3. *P. traversi koputaroa* Powell, 1946. Holotype, 52.5 x 27 mm. 4. & 5. *P. lignaria rotella* Powell, 1938. Topotypes. 6-8. *P. traversi latisona* n. subsp. Holotype (6) and Paratypes, 44 x 26 mm.

Without the umbilical colour zone: Cuvier Island (Auck. Mus.); Fletcher's Bay, Cape Colville (A.W.B.P.); Waioeka Gorge, between Opotiki and Gisborne, Awakino Gorge and Mt. Messenger (A.W.B.P.); Wanganui (Suter collection); Waiapehu Reserve and other localities around Levin (A.W.B.P.).

Some coloured, others plain, in each colony (percentages refer to coloured form); Pukekohe, south of Auckland, 66% (Suter collection); Waikato Heads, 75% (W. La Roche); and Midhurst, Taranaki, 50% (Suter collection).

In general the plain form which may be taken as the more primitive is southern and the coloured form of northern distribution. A curious exception is the occurrence of a plain form at Cuvier Island.

There are four records of *Rhytida greenwoodi* from South Island localities: (1) Lake Guyon Run, near source of Waiiau River (H. Suter, 1913, Man. N.Z. Moll., p. 775); (2) Takaka Valley, Nelson, a half-grown specimen collected by Dr. J. Henderson, 1922 (Powell, 1930, Rec. Auck. Inst. Mus. 1 (1), p. 29); (3) Left Bank of Lee, Wairoa Valley, Nelson, subrecent in cave, collected by Mr. F. V. Knapp (Powell, l.c. p. 29); and (4) on a talus-slope, subrecent? gorge of the Lower Waipara River, North Canterbury (R. S. Allan, 1937, Rec. Cant. Mus. 4 (3), p. 167).

The Lake Guyon specimen is not in the Suter collection, but I have re-examined the remaining three records, each based upon a single specimen. As far as can be judged on this scanty material, the reference to *greenwoodi* of the Lower Waipara example (25.75 mm. major diam. x 20.5 mm. min. diam.) is fairly certain, but the Wairoa Valley shell (24.5 mm. major diam. x 19 mm. min. diam.) is atypical in having seven strong, very widely spaced oblique spiral ridges which extend almost from the suture over on to the upper part of the base. It resembles a much larger fragmentary specimen (31.5 mm. major diam. x 26.5 mm. min. diam.) from a cave, "Takaka Mountains," Canterbury Museum. Both these subrecent shells, respectively, probably represent ancestral forms of *greenwoodi* and they are certainly distinct from the North Island subrecent species, *R. spelaea* (Powell, 1933, Proc. Malac. Soc. 20 (4), p. 192) from South of Cape Kidnappers. The Takaka half-grown shell has the coloration of the uncoloured North Island *greenwoodi* form, but a relatively higher spire.

Forms of *greenwoodi* are now so uncommon in the South Island that isolated occurrences have developed independent trends. The subspecies *webbi*, for instance, seems to be rare and extremely local.

***Rhytida greenwoodi webbi* n. subsp. Pl. 65, figs. 16, 17.**

Shell of similar size and general appearance to *greenwoodi*, but with a more depressed spire, more vertically compressed whorls (see last two columns in table of measurements below) and only obsolescent oblique transverse ridges on the peripheral area of the last whorl. These ridges number five, as in *greenwoodi*, but in most examples they are too indefinite to be counted. The radial sculpture is exactly as in *greenwoodi*—closely spaced retractorily oblique wrinkles, partly anastomosing, and forming an irregular network of elongated narrow meshes, especially on the dorsal surface.

Colour dark reddish-brown above and encroaching over the outer area of the base, rest of base yellowish to slightly greenish pale-brown and without an umbilical colour zone. Apertural and parietal callus pale purplish-brown, not bluish as in *greenwoodi*. Umbilicus between one-fifth and one-sixth major diameter of base.

greenwoodi greenwoodi

Major diam.	Min. diam.	Height.	Wh. th.*
26.0 mm.	20.5 mm.	15.5 mm.	9.5 mm. Muriwai, W. Coast
25.5 mm.	20.0 mm.	15.5 mm.	9.5 mm. Waikato Heads
25.5 mm.	20.4 mm.	15.5 mm.	9.75 mm. Muriwai, W. Coast
25.0 mm.	19.75 mm.	16.0 mm.	9.5 mm. Muriwai, W. Coast
25.0 mm.	20.5 mm.	16.5 mm.	9.0 mm. Waikato Heads
24.75 mm.	20.0 mm.	15.0 mm.	9.5 mm. Muriwai, W. Coast
24.0 mm.	19.0 mm.	16.0 mm.	9.5 mm. Waikato Heads
24.0 mm.	19.5 mm.	16.0 mm.	9.5 mm. Waikato Heads

greenwoodi webbi

26.5 mm.	20.25 mm.	13.5 mm.	8.5 mm. (holotype)
24.0 mm.	19.0 mm.	12.5 mm.	8.0 mm. (paratype)
23.5 mm.	18.9 mm.	12.45 mm.	8.0 mm. (paratype)
23.0 mm.	18.25 mm.	12.25 mm.	8.0 mm. (paratype)

* = whorl thickness, a vertical measurement from suture to base, in line with axis of shell.

Dentition: The radula of *webbi* is practically identical with that of *greenwoodi* typical. The laterals increase rapidly to the tenth, which is very large and massive, the vestigial eleventh is minute and ill-formed, and the central is only two-thirds the height of the nearest lateral. The largest lateral in the *greenwoodi* series lacks the median ridge of the *patula* series. The formula is 11 + 1 + 11, compared with 12 + 1 + 12 in the Waiuku example of *greenwoodi* typical (Powell, 1930, p. 28, text fig. 5), but the number and size of these vestigial outer laterals are subject to variation, as instanced by another Waiuku example which has only one vestigial lateral as in *webbi*.

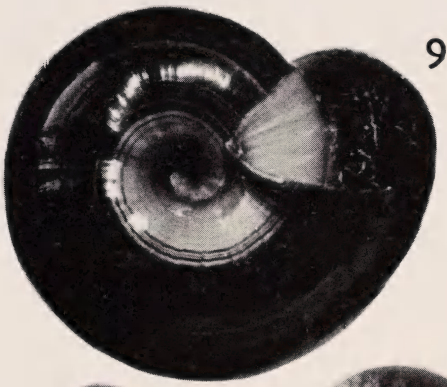
Locality: Clifton, Takaka, Nelson. Under clumps of *Astelia* amongst limestone. A. C. O'Connor, January, 1945. Rare and apparently very local.

This subspecies is named in honour of Mr. Eric Webb, of Takaka.

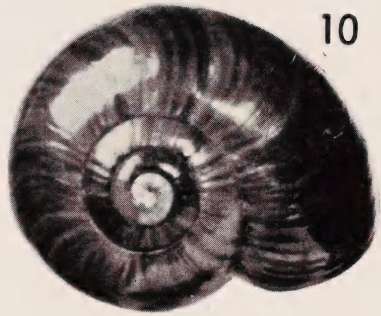
Holotype: In Auckland Museum.

***Rhytida hadfieldi* n. sp. Pl. 65, figs. 18, 19.**

Shell large, thin, translucent, largely chitinous, depressed, of $3\frac{3}{4}$ rapidly increasing whorls. Aperture very large, oblique, elongate-oval. Umbilicus deep, one-seventh to one-ninth the major diameter. Protoconch of $1\frac{1}{2}$ almost flat, finely radially ribbed whorls. Post-nuclear whorls finely malleated by a laterally compressed network of anastomosing radial ridges. The whole surface covered with exceedingly fine and dense wavy spiral striations. Seven to nine subobsolete, slightly oblique spiral ridges or folds at the periphery, too indefinite to be accurately counted. Colour, dark reddish-brown. A juvenile is light brown on the base, but with a dark reddish-brown zone in the umbilicus.



9



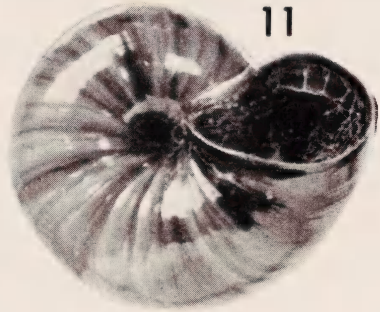
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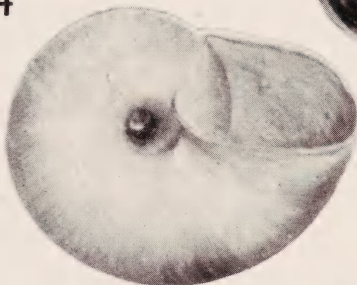
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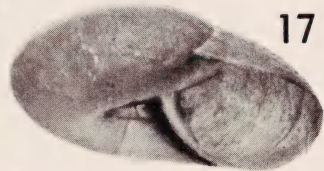
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19

9. *Paryphanta lignaria johnstoni* Powell, 1946. Ratcliffe Ridge. 10-12. *P. rossiana patrickensis* n. subsp. Holotype (10) and Paratypes, 36 x 21 mm. 13. *Schizoglossa novoseelandica* (Pfeiffer, 1862), Toko, near Stratford, 20 x 12.10 x 6 mm. 14. *S. novoseelandica barrierensis* n. subsp. Holotype, 20 x 13.25 x 6.25 mm. 15. *S. worthyae* n. sp. Holotype, 21.5 x 15.5 x 6 mm. 16, 17. *Rhytida greenwoodi webbi* n. sp. Holotype, 26.5 x 13.5 mm. 18, 19. *Rhytida hadfieldi* n. sp. Holotype (19) and Paratype, 32.4 x 18 mm.

Major diameter.	Minimum diameter.	Height.
32.4 mm.	24.0 mm.	18.0 mm. (<i>hadfieldi</i> , holotype)
33.0 mm.	25.0 mm.	18.5 mm. (<i>hadfieldi</i>)
30.0 mm.	23.0 mm.	18.5 mm. (<i>oconnori</i>)
26.3 mm.	21.0 mm.	16.0 mm. (<i>oconnori</i>)
23.0 mm.	16.3 mm.	12.0 mm. (<i>patula</i> , holotype)
20.0 mm.	15.0 mm.	12.0 mm. (<i>patula</i> , West Nelson)

Dentition: 16 + 1 + 16, laterals increasing to the fifteenth, which is very large and medially ridged, sixteenth very small with a poorly developed cusp.

Localities: Canaan, near headwaters of the Wainui River, Pikikiruna Range, Nelson (A. C. O'Connor, Jan., 1949). Awarua Bay, near Separation Point, Nelson, almost at sea-level (W. V. Hadfield and A. C. O'Connor, Feb., 1949).

A member of the *patula* group of species which includes, besides *patula*, *citrina*, *oconnori*, *meesoni*, *meesoni perampla*, *otagoensis*, and probably *australis*. They have very thin, almost entirely chitinous shells with rapidly increasing whorls resulting in a large, elongately oval aperture. A characteristic of the radula is the median ridge on the largest lateral.

The new species combines the shape of *patula* with the large size of *oconnori*. Compared with *patula* and *citrina*, *hadfieldi* has one and a half times the linear dimensions, is of a much darker brown colour and has a dental formula 16 + 1 + 16, which is the same as in the yellowish-olive coloured *citrina*. The formula for *patula* is 18 + 0 + 18. From the large sized subfossil *oconnori* from Punipaua Creek, West Nelson (Powell, 1946, Rec. Auck. Inst. Mus. 3 (2), p. 130), *hadfieldi* differs in having a wider umbilicus, more loosely coiled whorls, and only obsolescent peripheral ridges. In *oconnori* the umbilicus is one-thirteenth to one-fourteenth the major diameter of the base, compared with one seventh to one-ninth in *hadfieldi*.

The species is named after Mr. W. V. Hadfield, of Awarua Bay, Takaka, who forwarded to me some years ago a damaged specimen of this species found in a swamp.

Genus **SCHIZOGLOSSA** Hedley, 1892.

Proc. Linn. Soc. N.S.W. (2) 7, p. 30.

Type (monotypy): *Daudebardia novoseelandica* Pfeiffer.

Two distinct forms of Recent *Schizoglossa* have long been known to me and each is apparently a descendant of a much larger Pleistocene or post-Pleistocene species, i.e., *S. gigantea* Powell, 1930, and *S. major* Powell, 1938.

The distribution of the broadly ovate Recent *Schizoglossa* is Patumahoe, south of Auckland, north to Hokianga and eastward to near Paeroa. Its fossil ancestor is from Pukemiro, about 60 miles south of Auckland.

The distribution of the narrow oblong Recent *Schizoglossa* is Wai-tomo, southwards to Taupo, Taihape and Wanganui, and westward to Taranaki. Its fossil ancestor is from the Gisborne district. The genus is nowhere common, and the sporadic locality records are probably due to lack of intensive collecting.

A third Recent form occurs at Tryphena, Great Barrier Island, and its relationship, strangely, is with the narrow oblong form.

The difficulty now arises—which form represents the typical species?

Pfeiffer's description of his *novoseelandica* (1898, Monog. Helic. Viv. 5, p. 10) is as follows:—

"*T. imperforata, depressissima, ambitu ovalis, solidula, striis incrementi distinctis et lineis impressis radiantibus sculpta, fulva; spira minima, $\frac{1}{8}$ longitudinis occupans; anfr. $2\frac{1}{2}$ ultimus latere subcompressus; columella superne crasse callosa; apertura oblonga, intus submargaritacea.*—Long. 10, diam. 7, alt. $2\frac{1}{2}$ mill. (Coll. Nr. 4). Habitat in Nova Seelandia (Hochstetter)." Pfeiffer did not figure the species.

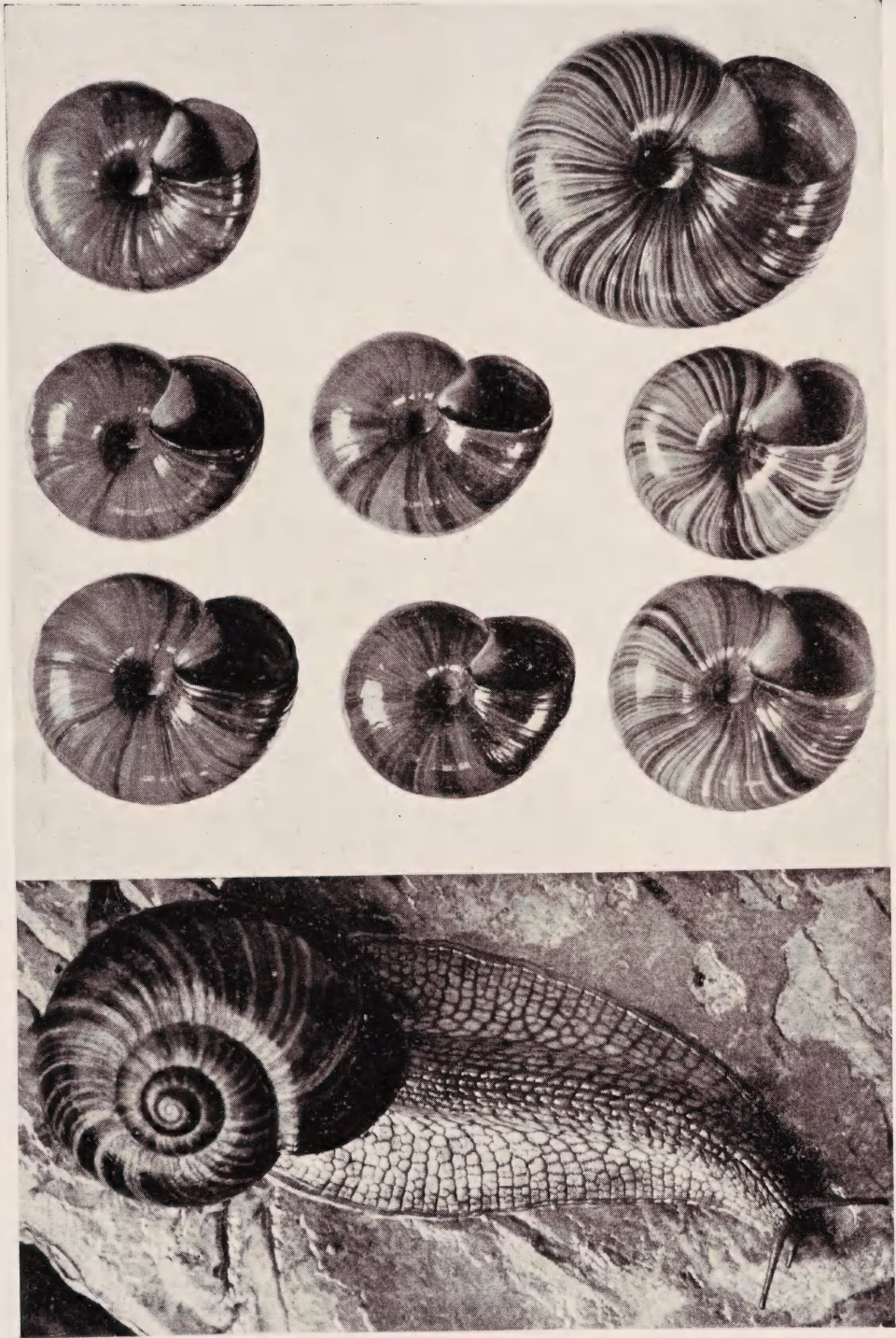
The following table gives dimensions of series representative of the three Recent forms and the two fossil species:—

(A) The broadly ovate form.

1. Recent. All from Mauku, near Patumahoe.			
	Length.	Diameter.	Thickness.
	8.75 mm.	6.00 mm.	3.00 mm.
	10.10 mm.	7.40 mm.	3.15 mm.
	12.40 mm.	9.40 mm.	3.60 mm.
	15.50 mm.	10.00 mm.	4.70 mm.
	18.30 mm.	13.25 mm.	4.75 mm.
	22.00 mm.	15.50 mm.	5.50 mm.
2. Subrecent. Pukemiro (<i>S. major</i>).			
	36.00 mm.	26.00 mm.	8.50 mm.

(B) The narrow oblong form.

3. Recent. Southern North Island.			
	5.80 mm.	4.00 mm.	2.00 mm. Atene.
	7.20 mm.	5.10 mm.	2.25 mm. Atene.
	10.30 mm.	6.60 mm.	2.60 mm. Toko.
	15.60 mm.	9.50 mm.	4.50 mm. Toko.
	20.00 mm.	12.10 mm.	6.00 mm. Toko.
4. Recent. Great Barrier Island.			
	6.25 mm.	4.25 mm.	2.0 mm.
	14.50 mm.	9.50 mm.	3.5 mm.
	20.00 mm.	13.25 mm.	6.25 mm.
5. Subrecent. Tahora, Gisborne (<i>S. gigantea</i>).			
	32.00 mm.	19.00 mm.	6.00 mm.



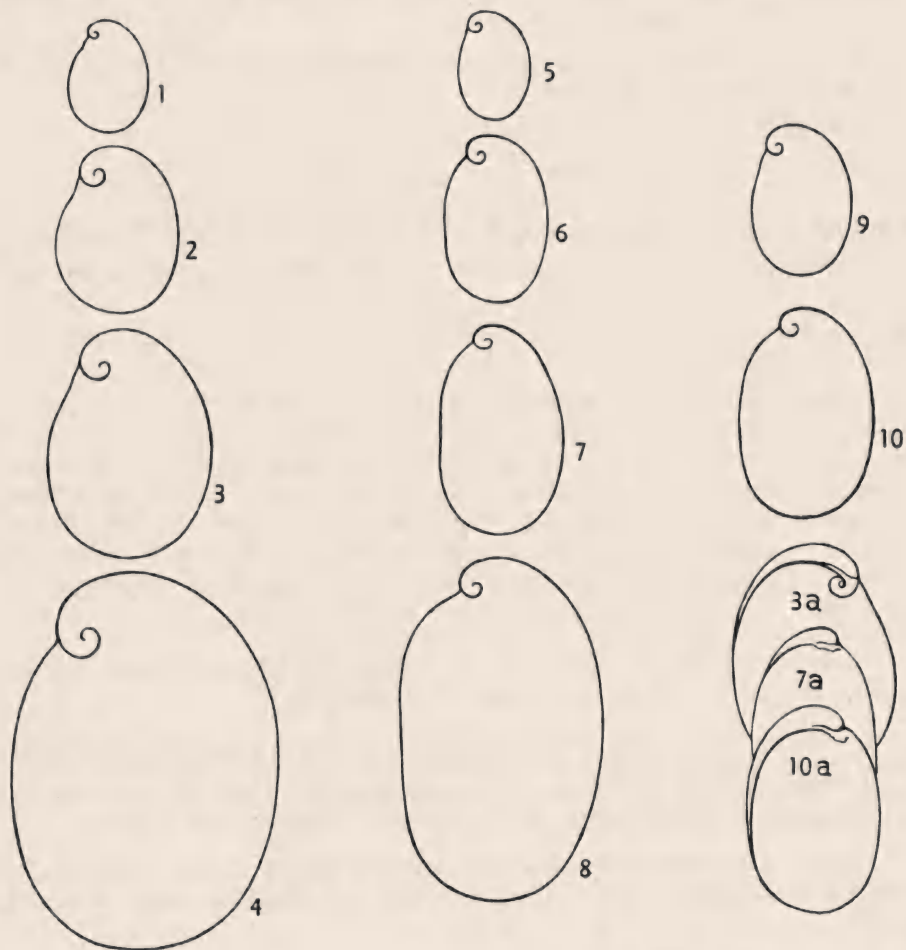
Above: *Summerlea* hybrids (*lignaria* × *unicolorata*); *unicolorata* dominant (top left); *lignaria* dominant (top right).

Below: *Paryphanta lignaria lusca* n. subsp. Glass-Eye Creek, Mokihinui-Karamca Road, with animal fully extended.

Wm. C. Davies, Photo.

Unfortunately Hochstetter's species seems to be extinct at the type locality, which is Kakepuku Mountain, Waikato, and neither the type specimen nor any material from reasonably near the type locality is available to me.

Pfeiffer's description, however, although brief, indicates the narrow oblong form as true *novoseelandica*. The significant points are the height in relation to the length and diameter (especially in young to half-grown examples), the spire occupying one-eighth of the length and the impressed linear sculpture.



TEXT FIG. B. *Schizoglossa*. 1-3. *worthyae* n. sp. 4. *major* (holotype). 5. *novoseelandica* (Ohakune). 6. *novoseelandica* (Taihape). 7. *novoseelandica* (Toko). 8. *gigantea* (holotype). 9, 10. *novoseelandica barrierensis* n. subsp. (All uniform scale.)

The broadly ovate form has the spire about one-fifth of the length, it is thicker or higher, and the sculpture is more irregularly-malleated than incised-linear. It is described following as a new species, *worthyae*, and is obviously descended from the large subrecent *major*.

The Great Barrier shells described below represent a new local subspecies of *novoseelandica*, and they in turn are clearly Recent derivatives of the subrecent *gigantea*.

The difference between the narrow oblong and the broadly ovate form is much more marked in the subrecent species than in their respective descendants, but since the divergence is of long standing it is more natural to accept specific rather than subspecific distinction in respect to the Recent shells.

Schizoglossa major Powell, 1938. Text fig. B4.

1938. *Schizoglossa major* Powell, Rec. Auck. Inst. Mus. 2 (3), p. 139, pl. 33, figs. 15, 16.

Locality: Subrecent, in limestone crevice with "moa" remains, $\frac{1}{2}$ mile S.W. of Pukemiro, Waikato, North Island.

(See table (A) 2, for dimensions.)

Holotype: Auckland Museum.

Schizoglossa worthyae n. sp. Pl. 65, fig. 15; text figs. B1-3, 3a.

1913. *Schizoglossa novoseelandica*: Suter (in part, not of Pfeiffer), Man. N.Z. Moll., p. 785.

1930. *Schizoglossa novoseelandica*: Powell (not of Pfeiffer), Rec. Auck. Inst. Mus. 1 (1), pl. 1, figs. 3, 4.

Shell auriform and depressed, much smaller than the animal, consisting of a thin, limy, broadly ovate shell, covered with a moderately thick olive-brown chitinous epidermis, grading to greenish-yellow at the margins. The surface is malleated by irregular wavy radiate striations. Concentric growth stages are clearly marked, somewhat ledged and defined by darker brown. Protoconch of $1\frac{1}{2}$ convex smooth brownish whorls. The spire occupies from one-fourth to one-fifth the length of the shell.

Length, 21.5 mm.; diameter, 15.5 mm.; thickness, 6.0 mm. (holotype) (see table (A) 1, for range of dimensions).

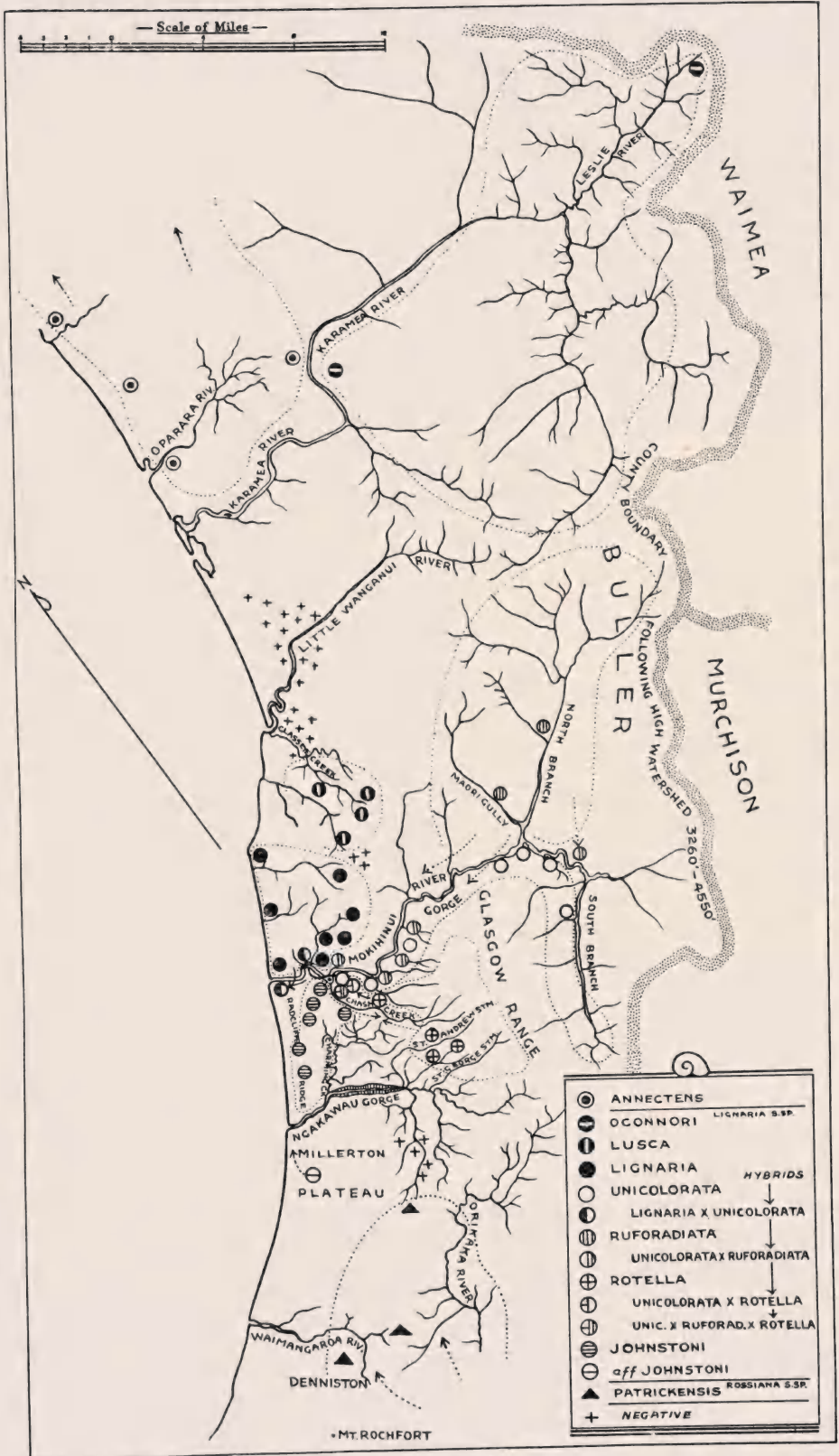
Localities: Mauku, near Patumahoe, South Auckland (type, Mrs. I. Worthy, 1947); South slope of Manaia, Whangarei Heads (A.W.B.P., 2/11/1919); Broadwood, Hokianga (Mr. R. Wynter); Karangahake Hill, 1,300 feet, near Paeroa; Tauranga side of Kaimai Range (A. E. Brookes); Mamaku, near Rotorua.

Eggs: Broadly elliptical, white and without a cuticle—4.25 x 3.5 and 4.5 x 3.5 mm. (See O'Connor, 1945, Trans. Roy. Soc. N.Z. 75, p. 54).

Radula: 26 + 0 + 26, Manaia, Whangarei Heads (Powell, 1930, l.c. p. 23, text fig. 2S). The laterals vary in number between 25 and 28. There is no apparent difference between the dentition of *worthyae* and *novoseelandica*.

Holotype: Auckland Museum.

The shell differs from that of *novoseelandica* in its more broadly ovate outline, relatively greater thickness or height, larger spire in relation to length, malleate sculpture and visible umbilicus, not overshadowed



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by the parietal wall. The subfossil *major* is clearly ancestral to *worthyae*. It is more regularly ovate than *worthyae* and much larger and more massive.

Named in honour of Mrs. I. Worthy, of Patumahoe, to whom I am indebted for the type series of specimens.

Schizoglossa gigantea Powell, 1930. Text fig. B8.

1930. *Schizoglossa gigantea* Powell, Rec. Auck. Inst. Mus. 1 (1), p. 54, pl. 1, figs. 5, 6.

Localities: Subrecent with "moa" bones, cave near Tahora, Gisborne District (type); Caves at Waikaremoana, and Mangaone Cave near Nuhaka, Hawke's Bay (H. Hill, 1933).

(See table (B) 5, for dimensions.)

Holotype: Powell collection, Auckland Museum.

This species differs from the other narrow oblong forms in being relatively much more depressed.

Schizoglossa novoseelandica (Pfeiffer), 1862. Pl. 65, fig. 13; text figs. B5-7, 7a.

1862. *Daudebardia novoseelandica*: Pfeiffer, Mal. Bl. 8, p. 146.

1868. *Daudebardia novoseelandica*: Pfeiffer, Monog. Helic. Viv. 5, p. 10.

1892. *Schizoglossa novoseelandica*: Hedley, proc. Linn. Soc. N.S.W. (2) 7, p. 387, pl. 9, figs. 1-3.

1913. *Schizoglossa novoseelandica*: Suter, Man. N.Z. Moll. (in part), p. 785.

Localities: Kakepuku Mountain, Waikato (type); entrance to glow-worm cave, Waitomo (A.W.B.P., Jan., 1949); Otonui, near Taumarunui (J. Peek); near Pio Pio (A.W.B.P., 1927); Pukemako, west side of Lake Taupo (A. C. O'Connor); Ohakune (P. C. Gardner); Taoroa, near Taihape (A. C. O'Connor); Atene, near Wanganui (A. C. O'Connor); Whangamomona, Taranaki (Miss L. B. Moore); Toko, near Stratford (Suter Coll.).

Length, 20.00 mm.; diameter, 12.10 mm.; thickness, 6.00 mm. (largest example).

(See table (B) 3, for range of dimensions.)

Eggs: Broadly elliptical without cuticle, not distinguishable from those of *worthyae*—4.5 x 3.5; 4.5 x 3.75; 4 x 3.25 mm. (See A. C. O'Connor, 1945, Trans. Roy. Soc. N.Z. 75, p. 54.)

Holotype: K. K. Hofmuseum, Vienna.

Schizoglossa novoseelandica barrierensis n. subsp. Pl. 65, fig. 14; text figs. 9, 10, 10a.

Shell oblong-ovate with a small spire about one-seventh the length, sculptured with radial slightly flexuose impressed linear striations, not malleated. The umbilicus is overshadowed by the parietal callus. The outline is similar to that of the typical species except that the shell is relatively wider and is not narrowly contracted anteriorly.

Length, 20.00 mm.; diameter, 13.25 mm.; thickness, 6.25 mm. (holotype). (See table (B) 4, for range of dimensions.)

Locality: Tryphena, near divide between west and east coast, Great Barrier Island (C. Osborne, April, 1924).

Holotype and two paratypes, Powell collection, Auckland Museum.